



Coconino County
Public Works Department

EARTHWORK STANDARDS

All earthwork shall be placed and tested in accordance with this section, unless otherwise stated by the County engineer, or his representative. No fill shall be placed without prior approval by the County Engineer, his representative, or the project engineering firm. Upon completion of the earthwork project, the project engineering firm must submit a *report* to the County Engineer. The report shall comply with the subheading in this section titled “*reports*”.

The following standards shall be considered the minimum standards to be used on Coconino County earthwork projects. Additional recommendations and specifications may also be incorporated for construction if stated in a project geotechnical report, or as shown on the project plans.

Engineered Fill All fill placed shall be considered “engineered fill” unless otherwise specified. Prior to fill placement, the existing surface shall be scarified to a minimum depth of 6”, then moisture conditioned to between -1% and +3% of optimum moisture, and compacted to a minimum of **90%** (per ASTM D 1557). All fill shall be placed in horizontal lifts. Fill shall contain no material with dimensions greater than 3” size, unless specifically approved, and placed as described under the *rock fill* section. Cinders shall not be used in engineered fills. Loose lift thickness shall be limited to 8” maximum.

All fill placed shall be observed and/or tested per the recommendations in the project geotechnical report, by an approved engineering firm. Any fill areas with a density test failure, or fill placed in a manner deemed unacceptable by the County, or the project engineering firm, shall be reworked to the satisfaction of the County, and the project engineering firm. Engineered fill shall not be placed over unacceptable fill.

Clearing and Grubbing Prior to fill placement, all surface vegetation shall be cleared to a minimum of 5 feet outside of fill areas, unless otherwise noted on plans. All vegetation, and any other debris removed from within the cleared area shall be hauled off site, unless otherwise specified by the County Engineer.

Roadway Fill The upper 6” of subgrade and the complete aggregate base section shall be compacted to a minimum of **95%** (per ASTM D 1557). Moisture conditioning and placement shall be performed as described under *engineered fill*. The subgrade and aggregate base sections must be stable, and free of soft, or pumping areas. Stability of the subgrade and aggregate base sections shall be confirmed visually and by proof-rolling, as necessary. Proof rolling shall be performed with a fully loaded water truck.

Trench Fill Trenches shall be bedded with a minimum 6" layer of aggregate base, unless otherwise approved by County Engineer, and then compacted as described under *engineered fill*. Bedding/shading shall be placed and compacted around pipes and conduits as specified by the utility owner, or the project specifications. All bedding shall be compacted to a minimum of **90%** (per ASTM D 1557).

Beneath paved and concrete areas all trench backfill placed over the bedding zone shall be a **2 sack slurry**. The slurry shall be placed to the top of the trench, level with the top of the adjoining aggregate base section. No soil or other material shall be placed as trench backfill, unless otherwise specified by the County Engineer.

Foundation Excavations Prior to placement of steel or concrete into foundation bottoms, the foundation excavation must be observed by a representative from the County Engineering Department, or a representative from the project engineering firm. The foundation must be free of loose material, water, snow, debris, or any other unacceptable material.

The foundation must be excavated to the width and depth per plan or project recommendations, and must be founded into dense native soil, or engineered fill. Foundations shall not be founded in expansive soil, unless otherwise recommended by a geotechnical engineer.

Differential support conditions may be a concern where foundations may be in cut and fill soils, or foundations cross native rock and engineered fill. A geotechnical engineer must be consulted to determine if overexcavation or other methods are necessary to help mitigate differential settlement.

Slope Fill and Construction Fill constructed against existing slopes steeper than 5:1 shall have a keyway constructed at the slope toe. The keyway width shall be ½ the slope height, or a minimum of 1½ the width of the compaction equipment used. The key bottom shall be sloped into the slope at a minimum of 2%. The toe of the key shall be excavated into dense soil or bedrock formation to a minimum depth of 18", or as directed by the County Engineer. As slope fill is placed, horizontal benches shall be cut into acceptable dense native soil or engineered fill. Compaction shall be performed as described under *engineered fill*. No material with dimensions greater than 3" shall be placed within 1 foot of the slope face.

Rock Fill Placement "Rock fill" will be considered material larger than 3" size, or when more than 30% of the material is greater than ¾" size, and therefore cannot be tested per ASTM D 1557. *Rock fill, and larger material may be placed in deeper fill areas, as approved by the County or the project engineer.* The rock fill lift thickness will be governed by the largest acceptable size material within the fill. Due to the generally untestable nature of the rock fill material, no density testing shall be performed. However, during the placement and compaction of the rock fill, full-time observation is necessary.

Predominantly granular material must be used as matrix soil in rock fills. The matrix soil shall have an SE of >32 (Sand Equivalency per ASTM D2419). The rock fill shall be placed so no voids are visible between the irreducible material, and no nesting is apparent. The rock fill shall be compacted at 2% to 8% above the optimum moisture of the matrix soil (finer than ¾" material, per ASTM D 1557).

Observation trenches shall be excavated as necessary (no less than every other lift) to visually confirm adequate densification, and to help confirm that the rock fill is free of nested material and/or voids. Should voids, nesting, loose material, or improper moisture content be observed, the unacceptable portion of rock fill shall be remixed and recompacted.

Safety During the construction process, all applicable “OSHA Standards for the Construction Industry” shall be followed, including (but not limited to) 29 CFR Part 1926, Subpart P - Excavations. All construction equipment and materials shall be safely fenced off from public access during the entirety of the project.

Knowing and following OSHA Safety Standards is the contractor’s responsibility. The County may stop construction on a project until safety concerns have been corrected.

Traffic Control Within all residential areas, and other County roadways, flaggers and construction warning signage shall be used during all construction, unless otherwise approved by the County Engineering Department. Flaggers shall be equipped with radio communication when not in full view of each other. Pilot vehicles used during paving and other roadway projects shall be clearly marked, be equipped with warning lights, and be in radio communication with flaggers at each end of the traffic control area.

Traffic control shall be maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), which is published by ATSSA/ITE/AASHTO, and approved by USDOT and the Federal Highway Administration (current edition).

A temporary traffic control plan shall be submitted to the County a minimum of 30 days prior to the commencement of any roadwork (or construction, where the contractor may be crossing the roadway with equipment during construction). The temporary traffic control plan shall conform to Part 6 - Temporary Traffic Control, in the MUTCD.

It is the contractor’s responsibility to comply with the temporary traffic control plan. The County may stop construction on a project until traffic safety concerns have been corrected.

Dust Control Dust and airborne particulate must be limited in all areas that a contractor is performing construction, or where equipment is driven to access the work area. Existing paved roadways, driveways, and other paved/concrete areas must be washed or swept free of dirt and debris daily, or as necessary.

The County may stop a project until dust and debris have been properly controlled.

Materials Aggregates, geotechnical fabrics, and all other project specific materials shall be as specified in the project geotechnical report, project plans, or approved as by the County Engineer.

Sampling and Testing of Soil and Aggregate

All sampling procedures for soil and aggregates shall be performed in accordance with current ASTM standard test methods, unless otherwise approved by the County Engineer, or noted below. **Laboratory testing, field sampling and testing, and inspection or observations, shall be performed by ATTI or NICET personnel only**, unless otherwise approved by the County Engineering Department.

Accepted test methods are:

Lab

Classification of soils, USCS	D2487 / 4.08
Dry preparation of samples	D421 / 4.08
Wet preparation of samples	D2217 / 4.08
Moisture content of soils	D2216 / 4.08
Determining minus 200 material by washing	D1140 / 4.08
Particle size analysis (Hydro and sieve)	D422 / 4.08
Liquid and Plastic Limits of soil (PI)	D4318 / 4.08
Specific gravity of soil	D854 / 4.08
Moisture - density of soil (Standard Proctor)	D698 / 4.08
Moisture - density of soil (Modified Proctor)	D1557 / 4.08
Moisture - density relations of soil - cement mixtures	D558 / 4.08
Resistance value of compacted soil (R-Value)	D2844 / 4.08
California bearing ratio (CBR)	D1883 / 4.08
Permeability of granular soil (constant head)	D2434 / 4.08
Consolidation	D2435 / 4.08
Expansion index (EI)	D4829 / 4.08
Direct shear	D3080 / 4.08
Unconfined compression	D2126 / 4.08
Sand equivalent test (SE)	D2419 / 4.03
Aggregate durability index	D3744 / 4.03
Bulk density and voids in aggregate	C29 / 4.02
Specific gravity & absorption of fine aggregates	C128 / 4.02
Specific gravity & absorption of coarse aggregates	C127 / 4.02
Sieve analysis of fine & coarse aggregates	C136 / 4.02
Abrasion of small aggregate (L.A. abrasion)	C131 / 4.02
Abrasion of large aggregate (L.A. abrasion)	C535 / 4.02
Soundness of aggregates by Sodium/Magnesium Sulfate	C88 / 4.02
Percentage of friable particles	C142 / 4.02
Reducing samples to test size (splitting samples)	C702 / 4.02
Total moisture content of aggregates	C566 / 4.02
Test for lightweight particles in aggregates	C123 / 4.02
Alkali - Silica reactivity of aggregate	C289 / 4.02
Fractured faces	ARIZ 212
PH and resistivity	ARIZ 236
Sulfate in soil	ARIZ 733

Field

Visual manual classification, USCS	D2488 / 4.08
Wet density by nuclear gauge	D2922 / 4.08
Moisture determination by nuclear gauge	D3017 / 4.08
In-place density by sand cone (6.5")	D1556 / 4.08
Density by the drive cylinder method	D2937 / 4.08

Testing Frequency Field density tests in engineered fill shall be taken at intervals no less than every 2 vertical feet or 100 lineal feet of fill placed, unless otherwise stated by the County Engineer or his representative.

Reports Upon completion of an earthwork project, an engineering report shall be submitted to the County Engineering Department. This engineering report shall be signed by a registered civil or geotechnical engineer. Included in the report shall be:

Density Test Results:

- Density tests shall be numbered consecutively, beginning with the first test taken on the project, ending with the last test taken on the project. Do not restart the numbering sequence each day.
- Each test failure must be retested at the same location and elevation. The retest number shall be designated by the original failure number, then with an "R" after the number (R designates retest).
- Test Date
- Location
- Elevation or depth
- Proctor number and soil description (USCS is important)
- Maximum density
- Field dry density
- Percent compaction (rounding to whole number is ok)
- Required compaction
- Pass / Fail (P or F is sufficient)
- Test locations must be shown on plot plans, with basic information such as a north arrow, street names, etc.

Lab Test Results:

- Test type, ASTM or other designation
- Soil description, include USCS
- Location sample taken from
- Each test must be signed and reviewed by Lab Manager

All reports shall be submitted to the County Engineering Department within 30 days after the completion of construction. At the request of the County Engineering Department, daily field reports, lab reports, or other information, may be requested during the construction of a project.

Dale Wegner, P.E.
County Engineer

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Construction Supervisor